sea level. This is contrary to measurements of the diameters of dust particles collected by means of an Owens dust counter by Mr. Hand during airplane flights up to 10,000 feet. It must be remembered, however, that in general such dust as is present in the atmosphere at a place like Calama, Chile, for example, is principally of local surface origin, and should not differ in size from surface dust at sea level.

Ångström's determinations fix the average diameter of atmospheric dust particles under normal conditions at about 1 micron, and indicate a considerable increase in diameter in August, 1912, when the source of the dust was principally the explosive eruption of Katmai Volcano in Alaska. From the width and angular dimensions of Bishop's ring, which has been shown to result from the diffraction of light by volcanic dust, the diameter of these dust particles has been computed to be 1.85 microns.

Ångström also finds that the variation in the value of β with height may be expressed by the equation $\beta_h = \beta_o\, e^{-\delta \times h}$ where $\delta = 0.69 \times 10^{-5}$; and, similarly, that the vertical variation in the number of atmospheric dust particles, as determined by Hand's measurements, may be expressed by the equation $N_h = N_o\, e^{-\phi \times h}$, where $\phi = 0.7 \times 10^{-5}$. It will be noted that the exponent of e in the two equations is practically the same.

Adopting for β_o and N_o the values 0.094 and 400, respectively, or approximately the mean of their respective values for Washington and Upsala, Ångström derives for Σ N, the number of particles in a vertical column 1 square centimeter in cross section, the value 5.6×10^7 He also derives the general expression $\beta = 1.79 \times 10^{-9}\, \Sigma$ N. From this latter the monthly mean values of β have been computed for Washington. They show a marked annual variation, with a maximum of 0.157 in May and a minimum value of 0.051 in November and December. As the author states, this does not agree with the annual variation in the number of dust particles found at the surface; but when we consider the probable value of the monthly means of Σ N we must take into account the difference in vertical distribution found by airplane measurements in August and November. Therefore, since convection is most active in late spring and early summer, and least active in late fall and early winter, there is nothing incongruous in the annual variation of β.

Summarizing, a more accurate way seems to have been found for computing the solar-spectrum energy distribution at the bottom of the atmosphere, except in the ultra-violet, where actual measurements are required. Also, the size of the dust particles as indicated by the value of a should be a clue to their source. For example, dust particles of volcanic origin appear to be larger than dust particles from the surface of the ground, while cosmical dust particles, which are thought to have been observed at times of sunspot maxima, probably are smaller. 551.524 (048)(215-17)

Temperature distribution up to 25 kilometers over the Northern Hemisphere.—K. R. Ramanathan, meteorological department, Poona, India, has published in Nature (London), June 1, 1929, a very interesting chart showing the distribution of temperature up to 25 kilometers over the Northern Hemisphere for summer and winter. (Fig. 1.) The broken lines (except that for 0° C.), the author states:

Are based on very few observations, and are therefore mainly conjectural. The principal features of the diagram may be briefly summarized.

(1) The stratosphere is not isothermal over any particular place, but above a certain level there is a tendency for the temperature to increase with height.

(2) The coldest air over the earth, of temperature about 185° A., lies at a height of some 17 geodynamic kilometers[1] over the Equator in the form of a flat ring surrounded by rings of warmer air.

(3) The surface of the tropopause has a relatively steep slope toward the pole between latitudes 30° and 50° in summer and between 25° and 45° in winter

(4) The ring of lowest temperature at the tropopause is displaced toward the summer hemisphere.

(5) There is a ridge of high temperature in the tropopause between latitudes 20° and 40° north in summer corresponding to the ridge of high pressure at 8 kilometers over those latitudes. (See Sir Napier Shaw's chart of 8 kilometers isobars in July, Manual of Meteorology, vol. 2, p. 262.)

A comparison of this chart has been made (by the reviewer) with the results of some recent aerological observations made in this country which were not included in the data comprising the chart. The average height and temperature of the tropopause as determined from a sounding balloon series made at Royal Center, Ind., in May, 1926, and at Groesbeck, Tex., in October, 1927, are

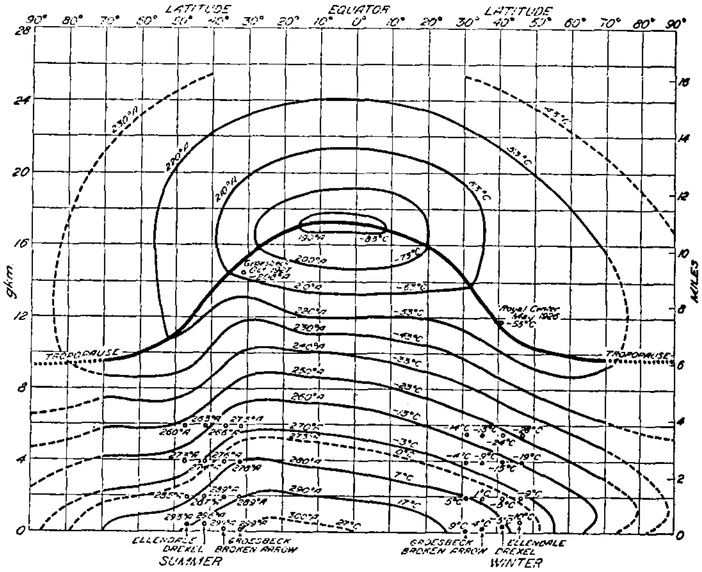

FIGURE 1.—Distribution of temperature up to 25 kilometers over the Northern Hemisphere

found to be in close agreement with the data depicted. These values are indicated at the corresponding points on the chart.

There are also indicated for comparison purposes the average temperatures at various heights as determined for summer and winter from kite observations made at four aerological stations in the United States, viz., Ellendale, N. Dak., latitude 45° 59′; Drexel, Nebr., latitude 41° 20′; Broken Arrow, Okla., latitude 36° 02′, and Groesbeck, Tex., latitude 31° 30′. While all of the latter do not coincide with the smoothed isotherms of the diagram, the general agreement is good, and the differences found are undoubtedly real and due to the greater extremes in temperature found in continental United States as compared to Europe.—*L. T. Samuels* 546.214 (048)

How high is the ozone layer?—By Charles Fitzhugh Talman.—For many years it has been known that a relatively large amount of ozone is present at high levels

[1] The following quotation from Manual of Meteorology, Volume 2, p. xx, by Sir Napier Shaw, will explain what is meant by geodynamic kilometers: "There is a good deal of laxity about the use of the word height, of the same kind as that of the aeronauts who graduate a pressure instrument to read what they call height. For example, V. Bjerknes and others would express the height of a point in the atmosphere by the geopotential at the point, calling the quantity expressed the dynamic height. We reproduce from the *Avant Propos* of the *Comptes rendus des jours internationaux*, 1923: 'The relation of the geopotential at any position to the geometric height of that position h and the gravitational acceleration g is $\Gamma = \int g dh$. The value is governed accordingly by the local value of gravity depending on the attraction of gravitation and the rotation of the earth, but not to any appreciable extent upon the condition of the atmosphere at the time of observation.'"

in the atmosphere, while only insignificant amounts are ever found, under natural conditions, near the earth's surface. The total amount present over any region can be measured, since the ozone absorbs sunlight of certain wave lengths and the amount of absorption can be determined with the spectroscope. On an average, it is found that the amount of this gas is such that, if it were under a pressure of one atmosphere and at a temperature of 32° Fahrenheit, it would make a layer about 0.12 inch thick. The actual amount is, in general, much greater in high latitudes than in low latitudes, and outside of the Tropics it is subject to rather wide variations, some of which appear to be connected with weather changes and have been the subject of much discussion.

A number of recent measurements have been made of the height of the "ozone layer" in the atmosphere. The method consists of measuring the absorption of sunlight due to ozone both when the sun is high and when it is low. The amount of absorption will vary with the length of the sunlight's path through the absorbing layer. When the sun is high the length of path through the layer will be the same whether the layer is high or low. When the sun is low (i. e., near sunrise or sunset), the path through the ozone layer will, on account of the curvature of this layer conforming to that of the earth, be longer if the layer is low than if it is high.

These measurements indicate that the average height of the ozone layer is between 25 and 30 miles. There is some evidence that its height varies, to a certain extent, with seasons and otherwise.

551.54 (048)

Is the semidiurnal barometric variation an electric phenomenon?—Prof. Fernando Sanford, in an article with the above title in Science, April 19, 1929, suggests that there is a very important relationship between the semidiurnal barometric variation and the semidiurnal electrometer variation. The method of presentation is graphic, and as the graphs can not be reproduced here, only a brief summary of the conclusions can be given.

Meteorologists have long felt that the 12-hour pressure variation, because it follows true local time, must be caused by some agency that does not affect the other meteorological elements, but hitherto no such agency has been discovered. Experiments with especially insulated electrometers have shown that "any insulated, unelectrified body near the surface of the earth, even if inside a closed hollow conductor, will be attracted twice daily by the electric charge of the earth, and it has seemed possible that the semidiurnal variation in barometric pressure may be due in some manner to this attraction. To test this surmise the diurnal variation in pressure as shown by the microbarograph was measured and recorded for the same 20 days for which the electrometer deflections were recorded." A graph of the two curves shows a considerable similarity between them.

"One thing that seems certain," says Professor Sanford, "is that the semidiurnal barometric variation is caused in some manner by solar influence. This is shown by both its daily and seasonal variations. Also the semidiurnal electrometer deflection must be due to the sun, as it has both a daily and a seasonal variation, being of greatest amplitude at the equinoxes and least at the solstices. In this respect it agrees closely with the semidiurnal curve. * * *

"There seems to be no reasonable doubt that the cause of the electropositive condition of the earth and the electronegative condition on the night side are due to the electrostatic induction of the sun's negative charge."—*N. H. B.*

551.513 (048)

Investigation of the oscillations of the general circulation (conclusion)[1]—*By A. Wagner, Innsbruck, Austria.*—The decades 1886–1895 and 1911–1920 were investigated with relation to change in the distribution of the different meteorological elements over the whole earth. These changes, represented in five charts, show the following:

1. The contrasts in air pressure, as they appear from the distribution of mean values over the earth's surface, are heightened in the latter decade. This leads to the conclusion of a uniform intensification in the general circulation. The cause thereof is most probably the greater permeability of the atmosphere for short-wave radiations in the decade 1911–1920 (fewer eruptions of ash, etc., by volcanoes).

2. Coincident with the intensification in the general circulation was a rise of about 3° C. in the mean temperature of the land surface and the continental shelves in agreement with the theoretical judgment of A. Defant. On the other hand, the surface of the deep sea probably became generally colder; the increased intermixing of the water surface, which parallels the intensification of the general circulation, is to be viewed as the cause of this.

3. Outside of narrowly limited regions with opposite anomaly, for which an explanation is found in local influences, the amplitude of yearly temperature became greater in the equatorial zone but smaller in the extratropical regions. The condition for the limiting line of this zone is the relation: Yearly oscillation of insolation = yearly oscillation of outward radiation. On account of the heat of vaporization (of water) the width of this equatorial becomes smaller, especially over the seas, in agreement with the facts of observation.

4. Apart from some local exceptions, the phase of the yearly temperature march was retarded in a wide equatorial zone and advanced in the extratropical regions; the limiting line is given by the condition: Mean insolation = mean outward radiation. Here, too, on account of the heat of vaporization the width of this equatorial zone becomes smaller; from observations there are found as the mean latitudes of this limitation the parallels of 35° N. and 32° S.

5. Just as the pressure contrasts have heightened, so have the contrasts in the distribution of precipitation been increased; increased precipitation in the zone of equatorial calms, diminished precipitation in the horse latitudes, and heavier precipitation in the higher latitudes having west wind drift.

The well-outlined relations between the force of the general circulation and the distribution of the several meteorological elements give a very clear and connected picture that is readily understandable from a physical viewpoint. In the study of these results and in the attempt to explain the different attendant phenomena in a consistent physical manner with relation to the general circulation, there arose a series of related problems to which I endeavored to find answers that are at least qualitatively correct. However, there yet remain in the locally limited anomalies different uncertainties in the given explanations, and these leave a more detailed local investigation desirable.

6. A whole series of correlation factors already well known is compared with the indications of the charts, and in by far the greater number of cases confirmation is found. The value of these correlation factors for forecasting purposes appears to rest solely on the fact that the general circulation shows a considerable tendency to maintain its condition.

[1] Geografiska Annaler. 1929. Heft I, pp. 80–82.